

Conservation and Transformation of Energy

PS-6 The student will demonstrate an understanding of the nature, conservation, and transformation of energy.

PS-6.1 Explain how the law of conservation of energy applies to the transformation of various forms of energy (including mechanical energy, electrical energy, chemical energy, light energy, sound energy, and thermal energy).

Taxonomy Level: 2.7-B Understand Conceptual Knowledge

Key Concepts:

Law of conservation of energy

Work

Energy/Energy forms: Mechanical energy, Electrical energy, Chemical energy, Light energy, Sound energy, Thermal energy

Energy transformation

Previous/Future knowledge: In the 6th grade students explained how energy can be transformed from one form to another (including the two types of mechanical energy, potential and kinetic, as well as chemical and electrical energy) in accordance with the law of conservation of energy (6-5.2). In Physical Science students will expand their concept of conservation of energy by applying the concept to transformations between various types of energy. Students will understand cause and effects relationships involved in transformations.

It is essential for students to understand that

- The *law of conservation of energy* states that energy cannot be created or destroyed. Energy can be transformed from one form to another, but the total amount of energy never changes.
- *Energy* is the property of an object or a system that enables it to do work.
 - *Work* is done when a force is applied to an object, and the object moves some distance in response to the force in the direction of the force.
 - *Work* is the product of the force applied to an object and the distance the object is moved in the direction of the force (displacement) (PS-6.3)
- If you consider a system in its entirety, the total amount of energy never changes.
- There are many different kinds of energy.
 - *Mechanical energy* is energy due to the position of something or the movement of something. Mechanical energy can be potential, kinetic, or the sum of the two.
 - *Chemical energy* is a type of energy associated with atoms, ions, and molecules and the bonds they form. Chemical energy will change to another form of energy when a chemical reaction occurs.
 - *Electrical energy* is energy associated with current and voltage.
 - *Thermal energy* is the energy associated with the random motion and arrangement of the particles of a material.
 - *Light energy* is energy that associated with electromagnetic waves.
 - *Sound energy* is energy associated longitudinal mechanical waves.
- These different kinds of energy can change from one form to another (*energy transformation*) without changing the total amount of energy. Examples might include:

Example 1

 - Explain conservation of energy in terms of energy transformation in an electric circuit with a battery and a light bulb burning.
 - Chemical energy changes to electrical energy.

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- The electrical energy flows through the light bulb and turns electrical energy to light and thermal energy.
- The total of the energy from the chemical reaction in the battery is equal to the total energy that it transforms into.

Example 2

- Explain conservation of energy in terms of energy transformation when a baseball is thrown to another ball player.
 - A ballplayer converts chemical energy from the food he/she has eaten to mechanical energy when he/she moves his/her arm to throw the ball.
 - The work done on the ball converts the energy of the arm movement to kinetic mechanical energy of the moving ball.
 - As the ball moves through the air, it has both kinetic and potential mechanical energy.
 - When a second player catches the ball, the ball does work on the player's hand and glove giving them some mechanical energy.
 - The ball also moves the molecules in the glove moving them faster and thus heating the glove.
 - The player that catches the ball absorbs the energy of the ball, and this energy turns to heat.
 - The total heat produced is equal to the energy used to throw the ball.
- Most energy transformations are not 100% efficient. When energy changes from one form to another, some of the original energy dissipates in the form of energy that is not usable. Usually it dissipates as heat.

It is not essential for students to

- Explain the chemical reaction that releases chemical energy.

Assessment Guidelines:

The objective of this indicator is to explain how the law of conservation of energy applies to energy transformations, therefore, the primary focus of assessment should be to construct a cause and effect model showing that energy is conserved as it continually transforms from one type to another.

Assessments should require that students understand transformation of different types of energy and the relationship of this transformation to the conservation of energy.

In addition to explain, assessments may require that students

- Exemplify energy transformations;
- Compare the forms of energy;
- Infer the transformations of different types of energy within given situations;
- Summarize major points about energy transformations;
- Recall the forms of energy.